

PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

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| Applicant's or agent's file reference FP-09-0915 | FOR FURTHER ACTION | | See Form PCT/IPEA/416 |
| International application No. PCT/GB2004/004569 | International filing date (day/month/year) 28.10.2004 | Priority date (day/month/year) 31.10.2003 | |
| International Patent Classification (IPC) or national classification and IPC B60M1/28, B60L5/20 | | | |
| Applicant MORGANITE ELECTRICAL CARBON LIMITED et al. | | | |
| <p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 9 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> <i>sent to the applicant and to the International Bureau</i> a total of 2 sheets, as follows:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions). <input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box. <p>b. <input type="checkbox"/> <i>(sent to the International Bureau only)</i> a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p> | | | |
| <p>4. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Box No. I Basis of the opinion <input type="checkbox"/> Box No. II Priority <input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability <input checked="" type="checkbox"/> Box No. IV Lack of unity of invention <input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement <input type="checkbox"/> Box No. VI Certain documents cited <input type="checkbox"/> Box No. VII Certain defects in the international application <input type="checkbox"/> Box No. VIII Certain observations on the international application | | | |
| Date of submission of the demand 10.05.2005 | Date of completion of this report 27.12.2005 | | |
| Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016 | Authorized Officer Bolder, G Telephone No. +31 70 340-3636 | | |



**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

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Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
 - This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:
 - international search (under Rules 12.3 and 23.1(b))
 - publication of the international application (under Rule 12.4)
 - international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

Description, Pages

1-15 as originally filed

Claims, Numbers

8-13, 19-22 as originally filed
1-7, 14-18 received on 06.12.2005 with letter of 02.12.2005

Drawings, Sheets

1/6-6/6 as originally filed

- a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. The amendments have resulted in the cancellation of:

- the description, pages
- the claims, Nos.
- the drawings, sheets/figs
- the sequence listing (*specify*):
- any table(s) related to sequence listing (*specify*):

4. This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- the description, pages
- the claims, Nos.
- the drawings, sheets/figs
- the sequence listing (*specify*):
- any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

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Box No. IV Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees, the applicant has:
 - restricted the claims.
 - paid additional fees.
 - paid additional fees under protest.
 - neither restricted nor paid additional fees.
2. This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is
 - complied with.
 - not complied with for the following reasons:
see separate sheet
4. Consequently, this report has been established in respect of the following parts of the international application:
 - all parts.
 - the parts relating to claims Nos. .

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | |
|-------------------------------|-------------|------|
| Novelty (N) | Yes: Claims | 1-22 |
| | No: Claims | |
| Inventive step (IS) | Yes: Claims | 1-22 |
| | No: Claims | |
| Industrial applicability (IA) | Yes: Claims | 1-22 |
| | No: Claims | |

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item IV

Lack of unity of invention

This Authority considers that there are 2 inventions covered by the claims indicated as follows:

- I: Claims 1-6 directed to a current collector comprising one or more Fibre Bragg Grating sensors.
- II: Claims 7-22 directed to a monitoring system for electrical vehicles comprising detector means in a current collector.

The reasons for which the inventions are not so linked as to form a single general inventive concept, as required by Rule 13.1 PCT, are as follows:

The only common technical feature for both subjects is "a current collector comprising detector means (e.g. a sensor)." This is known and does not form a special technical feature. The special technical feature of subject I is "a Fibre Bragg Grating Sensor", which is different from the special technical feature of subject II: "a monitoring system".

In conclusion, the groups of claims are not linked by common or corresponding special technical features and define 2 different inventions not linked by a single general inventive concept.

The application, hence does not meet the requirements of unity of invention as defined in Rules 13.1 and 13.2 PCT.

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

A INVENTION 1: Claims 1-6

A1 Reference is made to the following document:

D1: US 2001/026362 A1 (GLEINE ET AL.) 4 October 2001 (2001-10-04)

A2.1 The document D1 is regarded as being the closest prior art to the subject-matter of claim 1 and shows (the references in parentheses applying to this document):

A sensor arrangement for sensing temperature and strain comprising an optical fibre with a Bragg Grating arranged on a substrate and embedded in a cover layer (abstract, first sentence)

The subject-matter of claim 1 differs from this known sensor arrangement in that the sensor is provided within the current collector.

A2.2 The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

A2.3 The problem to be solved by the present invention may be regarded as how to let the sensor provide optimal information while being protected.

A2.4 The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

Embedding a Fibre Bragg Grating sensor within a current collector is not obvious. The closest prior art (D1) shows a sensor on top of a surface and embedded in a separate cover layer, there is no hint to the solution as disclosed in the application.

A3 Claims 2-5 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

B INVENTION 2: Claims 7-22

B1 Although claims 7,15 and 16 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter (a monitoring system comprising sensors) and to differ from each other only with regard to the definition of the subject-matter for which protection is sought. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT.

B2.1 Reference is made to the following documents:

- D1: US 2001/026362 A1 (GLEINE ET AL.) 4 October 2001 (2001-10-04)
- D2: JP 2002 187552 A (HITACHI INFORMATION & CONTROL SYSTEMS) 2 July 2002 (2002-07-02)
- D3: GB-A-1 374 972 (MORGANITE CARBON LIMITED) 20 November 1974 (1974-11-20)
- D4: EP-A-0 269 307 (MORGANITE ELECTRICAL CARBON LIMITED) 1 June 1988 (1988-06-01)
- D5: DE 202 13 180 U (GBM GLEISBAUMECHANIK BRANDENBURG/H GMBH) 28 November 2002 (2002-11-28)

B2.2 The document D6 was not cited in the international search report. A copy of the document is appended hereto.

- D6: US 6418397 B1 (BRAND ET AL.) 9 July 2002 (2002-07-09)

B3.1 The document D4 is regarded as being the closest prior art to the subject-matter of claim 7 and shows (the references in parentheses applying to this document): a monitoring system (condition indicator system) for electric vehicles drawing current from conductors, the system comprising detector means to indicate a current collector condition and a damage signal (column 1, lines 47-54).

The subject-matter of claim 7 differs from this known system in that there is a means to indicate the location on the conductor where the damage signal on the collector was generated.

B3.2 The subject-matter of claim 7 is therefore new (Article 33(2) PCT).

B3.3 The problem to be solved by the present invention may be regarded as how to find the location on the conductor where the damage signal on the collector was generated.

B3.4 The solution to this problem proposed in claim 7 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

It is not obvious, nor is there any indication in the prior art to have a locating system operatively connected to the detector means.

B4.1 The document D6 is regarded as being the closest prior art to the subject-matter of claim 15 and shows (the references in parentheses applying to this document):

A monitoring system for electric vehicles drawing electric current from overhead conductors through current collectors on pantographs comprising detector means under the collector to generate a signal indicative of force acting on the current collector (abstract).

The subject-matter of claim 15 differs from this known system in that the detector means is located within the collector and that there are means to indicate the location on the conductor where the damage signal on the collector

was generated.

B4.2 The subject-matter of claim 15 is therefore new (Article 33(2) PCT).

B4.3 The problem to be solved by the present invention may be regarded as how to find the location on the conductor where the damage signal on the collector was generated.

B4.4 The solution to this problem proposed in claim 15 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:
It is not obvious, nor is there any indication in the prior art to have a locating system operatively connected to the detector means.

B5.1 The document D6 is regarded as being the closest prior art to the subject-matter of claim 16 and shows (the references in parentheses applying to this document):
A monitoring system for electric vehicles drawing electric current from overhead conductors through current collectors on pantographs comprising sensors under the collector to generate a signal indicative of force acting on the current collector (abstract).
The subject-matter of claim 16 differs from this known system in that the detector means is a Fibre Bragg Grating sensor located within the collector.

B5.2 The subject-matter of claim 16 is therefore new (Article 33(2) PCT).

B5.3 The problem to be solved by the present invention may be regarded as how to let the sensor provide optimal information while being protected.

B5.4 The solution to this problem proposed in claim 16 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

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Embedding a Fibre Bragg Grating sensor within a current collector is not obvious. Prior art (D1) shows a sensor on top of a surface and embedded in a separate cover layer, while prior art (D6) shows a force sensor located under the collector. There is no hint to the solution as disclosed in the application.

B6.1 Claims 8-14 are dependent on claim 7 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

B6.2 Claims 17-22 are dependent on claims 7,15 or 16 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

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CLAIMS

1. A current collector comprising one or more Fibre Bragg Grating sensors mounted within the current collector.
2. A current collector, as claimed in Claim 1, in which at least one of said Fibre Bragg Grating sensors comprises a strain grating and a compensating temperature grating combined in one unit.
3. A current collector, as claimed in Claim 1 or Claim 2, comprising a carbon collector body and a metal carrier.
4. A current collector as claimed in Claim 3, in which Fibre Bragg Grating strain gauges are situated on or within the metal carrier.
5. A current collector as claimed in Claim 3, in which the Fibre Bragg Grating strain gauges are situated on or within the carbon collector body.
6. A current collector, as claimed in any one of Claims 3 to 5, in which Fibre Bragg Grating temperature gauges are situated at the carbon collector body/metal carrier interface.
7. A monitoring system for electric vehicles drawing current from conductors, the system comprising
 - i) detector means in the collector to indicate a current collector condition and/or damage signal at a predetermined level likely to cause damage to the conductor;
 - ii) locating means operatively connected to said detector means to generate a signal indicating the location of the current collector on the conductor at which the current collector damage signal was generated.

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- iii. a positioning system which is linked to the micro-controller and which locates the current collector at the time of said wear/damage; and
- iv. a display unit which displays the level of wear/damage and location on the conductor of the current collector.

15. A monitoring system for electric vehicles drawing current from overhead conductors through current collectors on pantographs, the system comprising

- i) detector means in the collector to generate a signal indicative of force acting on the current collector;
- ii) locating means operatively connected to said detector means to generate a signal indicating locations of the pantograph on the overhead conductor at which the signal indicative of force acting on the current collector exceeds a level likely to cause damage to the overhead conductor.

16. A monitoring and control system for electric vehicles drawing current from overhead conductors through current collectors on pantographs, the system comprising Fibre Bragg Grating sensors mounted within the current collector to indicate the forces acting on the current collector, and control means to process signals from the detector means and to generate control signals for the pantograph.

17. A monitoring and control system for electric vehicles, as claimed in Claim 16, in which the pantograph is controlled such that as the force on the current collector increases, the upward force on the pantograph is decreased (or *vice versa*) so as to maintain the forces experienced by the current collector within a chosen range.

18. A monitoring and control system for electric vehicles, as claimed in Claim 15 or 17, in which the detector means is a Fibre Bragg Grating strain gauge.